Implementation of SABSOON

Harvey Seim, phone (919) 962-2083 email harvey_seim@unc.edu
John Bane, phone (919) 962-0172 email bane@email.unc.edu
Francisco Werner, phone (919) 962-0269 email cisco@email.unc.edu
Department of Marine Sciences, University of North Carolina, Chapel Hill, NC 27599-3300
fax (919) 962-1254

Jackson Blanton, phone (912) 598-2457 email jack@skio.peachnet.edu
Richard Jahnke, phone (912) 598-2491 email rick@skio.peachnet.edu
James Nelson, phone (912) 598-2473 email nelson@skio.peachnet.edu
Gustav-Adolf Paffenhöfer, phone (912) 598-2489 email cmp@skio.peachnet.edu
Skidaway Institute of Oceanography, 10 Ocean Science Circle, Savannah, GA 31411
fax (912) 598-2310

Mary Ann Moran
Department of Marine Sciences, University of Georgia, Athens, GA 30602-3636
Phone (706) 542-6481 fax (706) 542-5888 email mmoran@uga.cc.uga.edu

Richard Zepp
National Exposure Research Laboratory, Ecosystems Research Division, U.S. Environmental Protection Agency, 960 College Station Rd, Athens, GA 30605-2700
Phone (706) 355-8117 fax (706) 355-8104 email zepp.richard@epamail.epa.gov

Award Number: N00014-98-1-0786
http://www.skio.peachnet.edu/projects/sabsoon.html

LONG-TERM GOALS

We are developing an interdisciplinary real-time coastal ocean observing network to provide users with continuous information on coastal ocean conditions. A number of applications for this network are being pursued. Resource managers and the weather service are using the routinely observed data to better predict and manage the use of the South Atlantic Bight (SAB) coastal waters. Academic researchers are using the network for targeted research and as a test bed for sensor development. The network will also serve as the nucleus of an observing system that will provide in-situ observations for a nowcast/forecast regional coupled ocean/atmosphere model of the SAB.

OBJECTIVES

The continuing implementation of the South Atlantic Bight Synoptic Offshore Observational Network (SABSOON) involves expanded deployment of data acquisition and sensor carriage systems at as many of the eight offshore platforms as possible, refinement of an onshore data management and distribution system, and coordination with the assimilative modeling group. A focus at this time is the deployment of communications and power systems at the outer (remote) towers. We continue to develop a flexible offshore facility that can host a variety of scientific, educational and environmental monitoring activities.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 SEP 2001		**00-00-2001 to 00-00-2001**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Implementation of SABSOON	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Department of Marine Sciences,University of Georgia,,Athens,,Athens,,GA, 30602**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

We are developing an interdisciplinary real-time coastal ocean observing network to provide users with continuous information on coastal ocean conditions. A number of applications for this network are being pursued. Resource managers and the weather service are using the routinely observed data to better predict and manage the use of the South Atlantic Bight (SAB) coastal waters. Academic researchers are using the network for targeted research and as a test bed for sensor development. The network will also serve as the nucleus of an observing system that will provide in-situ observations for a nowcast/forecast regional coupled ocean/atmosphere model of the SAB.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**7**	

APPROACH

In collaboration with the southeast Tactical Aircrew Combat Training System (TACTS), offshore platforms, or towers, owned and operated by the U.S. Navy are being instrumented with oceanographic and meteorological sensors. The effort involves interfacing science power and communications needs with existing TACTS equipment on the platforms. At each tower instrument systems are deployed which are for the most part readily serviced from the platform (i.e., without a ship or divers). Power is generated on-site, and data are relayed in real time by wireless communications to shore. Storage at each instrumented platform is used to buffer the data and provide a backup in cases of tower-to-shore communications failure. Onshore, the observations are archived, processed, and distributed to various users. These currently include academic researchers and the National Weather Service. Recent observations are also made available through the Skidaway web site (www.skio.peachnet.edu/ projects/tower.html). Coordination of activities with the modeling group is also a priority at this time. Collection and analysis of complementary datasets and databases will aid in the interpretation of SABSOON observations and is required for nowcasts of the coastal ocean.

WORK COMPLETED

Phase 2 of the project, the extension of the network to multiple towers, is underway. Two master platforms, R2 and M2, are fully instrumented, R2 since October 1999 and M2 since September 2000 (see Seim 2000 for details). Observations from all instruments in the network are collected at least every six minutes and relayed once an hour to Skidaway Institute over a wireless microwave local area network. The Navy systems on the larger master platforms provide sufficient power and communications bandwidth to accommodate the basic SABSOON requirements (an allowance of 300 W, 24 V DC; T1-equivalent bandwidth). However the smaller remote platforms have only solar panel arrays for power generation, use radio frequency communications to the masters and lack a climate controlled instrument room. After discussions with TACTS personnel, it was decided that it was necessary to establish independent power and communications systems for SABSOON at the outer remote platforms. This entailed considerably more engineering design, material costs, and helicopter time than was originally anticipated. However, this will ensure that SABSOON systems can operate continuously without demand on the Navy power and communications systems, and have sufficient power and communications capacity for future expansion of the sensor suite.

Installation of power and communications hardware began at R8 in March 2001, with modifications of the battery/instrument enclosure and transport of eight 24 V battery modules (each weighing about 430 lbs) to the platform. The TACTS solar panel frame was extended and new panels were installed for SABSOON use along with a charge controller and power monitoring system in April. Microwave antennas were installed in June. It was anticipated that the R8 installations would be completed during the summer of 2001. However, the focus of effort by engineering and support personnel had to be shifted to trouble-shooting and repairing the SABSOON systems at R2 and M2 during this period. In brief, the systems are R2 and M2 suffered cabling failures, the offshore computers were compromised by internet viruses, lightning damaged electronics components at the installations, and the TACTS power systems have experienced a series of failures. TACTS personnel have reported no prior problems with lightning damage to their systems in over 10 years of operation, and SABSOON systems had previously not been affected in the prior 2 years. However, TACTS does not have in-water instruments, and their transmission lines are grounded to the tower at intervals, while

SABSOON in-water systems were deliberately isolated from the tower to inhibit electrolysis. Current plans are to complete installation at R8 over the fall and winter of 2001-2002.

A significant improvement of an artificial reef located near one of the towers was recently accomplished. The artificial reef units were intended to attract reef fish directly in view of six cameras mounted on a central unit that are connected to the tower by cabling and permit real-time video transmission. Due to deteriorating weather conditions during the original deployment in 1999, the large concrete pyramids were not optimally positioned and several cameras viewed bare sand areas. Repositioning the units required underwater engineering expertise. This was provided by a U.S. Navy dive team (Explosive Ordnance Disposal, Mobile Unit Twelve) and NURC/UNCW who successfully repositioned the thirteen concrete pyramids around the central camera unit in June, 2001.

Raw and processed data from each instrument package are archived by month at the Skidaway Institute, with automatic backup on a RAID device. A relational database for the processed SABSOON data is being developed with the assistance of a database specialist at Skidaway who is supported through a separate, complementary project (NSF/SURA "Cast-Net"). A separate database for the instrument inventory/calibration/servicing records will be tied into an FGDC-compliant metadata entry and inquiry tool developed by Cast-Net personnel. SABSOON personnel are involved in "beta-testing" of this system. SABSOON processed data and metadata records will be made available on the web using a dedicated server at Skidaway.

Development of a climatology for the South Atlantic Bight is necessary for the data assimilative modeling effort to advance. The Hydrobase observational database (Curry, 1996) has been used as a starting point to take advantage of the error checking used in forming the database. Some additional error checking has been necessary but has resulted in a collections of temperature and salinity profiles on which to base subsequent analysis.

RESULTS

As we enter our third year of coastal mesonet operation, we continue to gain experience. The summer of 2001 was a lesson in troubleshooting. Although bio-fouling of optical equipment continues to be the most significant problem in maintaining data quality, the system was plagued by a series of hardware failures that diverted our attention away from continued expansion of the network. The internet attacks on the offshore computers, which are part of the Skidaway LAN, have revealed the vulnerability of the system as a public access network. As a result, the offshore computers have been put on a "private network" that should not be accessible directly from the internet. The lightning damage came as a surprise given the extensive grounding systems used by TACTS and 2 years of problem-free operation. One of the engineering tasks over the winter will be to consider options to better protect the vulnerable components of the SABSOON systems from lightning damage. The problems with the Navy's power systems further complicated the situation.

The observational database from SABSOON is being actively analyzed. Extreme wind events associated with squall lines occurred repeatedly between spring and fall. As presented at the fall meeting of the American Geophysical Union (Seim et al., 2000), these have been interpreted as marine downbursts (Fujita, 1985). Continuous meteorological and oceanographic measurements have also been obtained through hurricanes and strong winter storms. Sediment resuspension during the stronger storms, detected by in-water optical sensors at the towers, indicated that these events could play an important role in shelf biogeochemistry through the mobilization and redistribution of organic matter.

A significant increase in chlorophyll fluorescence during storms is consistent with suspension of benthic microalgae from the shelf sediments (Nelson et al. 1999). Seasonal episodes of cross-shelf exchange are also evident in the depth-averaged ADCP current records, often occurring when the sign of the cross-shelf density gradient changes due to cooling and warming of shelf waters and changes in freshwater discharge along the coast. The optical signature of lower salinity coastal water at R2 has been evident from measurements of the fluorescence of colored dissolved organic matter (CDOM).

A graduate student working with Seim is analyzing the 1.5 year ADCP current record to estimate bed stress and eddy viscosity. Preliminary modeling results display considerable sensitivity to these parameters and make the observational analysis of particular interest. Specific goals are to search for variability in bed stress and eddy viscosity associated with varying stratification and intensity of the surface wave field. A variety of other activities continue to be pursued (see previous reports).

Development of a monthly climatology is proceeding but it is clear that the paucity of hydrographic data seaward of the shelf break may severely limit accuracy. The temperature database at the National Oceanographic Data Center (NODC) is more that 10 times the size of the paired temperature/salinity database and may therefore be a useful source of additional information. Being able to utilize the temperature observations requires estimation of salinity values, and towards this end a temperature/salinity climatology for the SAB has been developed (Figure 1). The T/S relationships are presented for each 0.5 degree square within the SAB and provide a remarkably clear presentation of the extent of fresh water influence on the shelf and slope and the position of the Gulf Stream. Closer inspection reveals the route of the Deep Western Boundary Current and the region of influence of South Atlantic waters passing through the Florida Straits (Schmitz et al., 1993).

SABSOON investigators have also participated in a number of workshops and steering committees discussing the development of ocean observing systems (2 presentations before the U.S. Global Ocean Observing System Steering Committee) and have given presentations about SABSOON at 4 national scientific meetings in the last year.

IMPACT/APPLICATIONS

Full implementation of SABSOON will provide the scientific community, resource managers, and educators with real-time access to the coastal ocean. We feel this will enhance our understanding of the physics, biogeochemistry and ecology of the coastal zone, provide a monitoring system for coastal resources and coastal hazards, and a interactive observational system that can be used by educators to study coastal issues.

TRANSITIONS

Observations collected by SABSOON are being shared with a number of investigators. Tower R2 is a registered CMAN (Coastal Marine Automated Network) station (ID SPAG1) and hourly observations are transmitted to the World Meteorological Organization's Global telecommunications systems and available worldwide. Dr. Dana Savidge (currently at NOAA's Pacific Marine Environmental Laboratory) is investigating Gulf-Stream forcing of the shelf with the observations, and Drs. Susan Lozier (Duke Univ.) and Larry Pratt (WHOI) are using SABSOON tide and current observations in their studies of predictability of non-linear systems. Dr. Jim Demmers (Ga. Tech. Res. Inst.) is pursuing development of interactive K-12 educational units using the SABSOON observations.

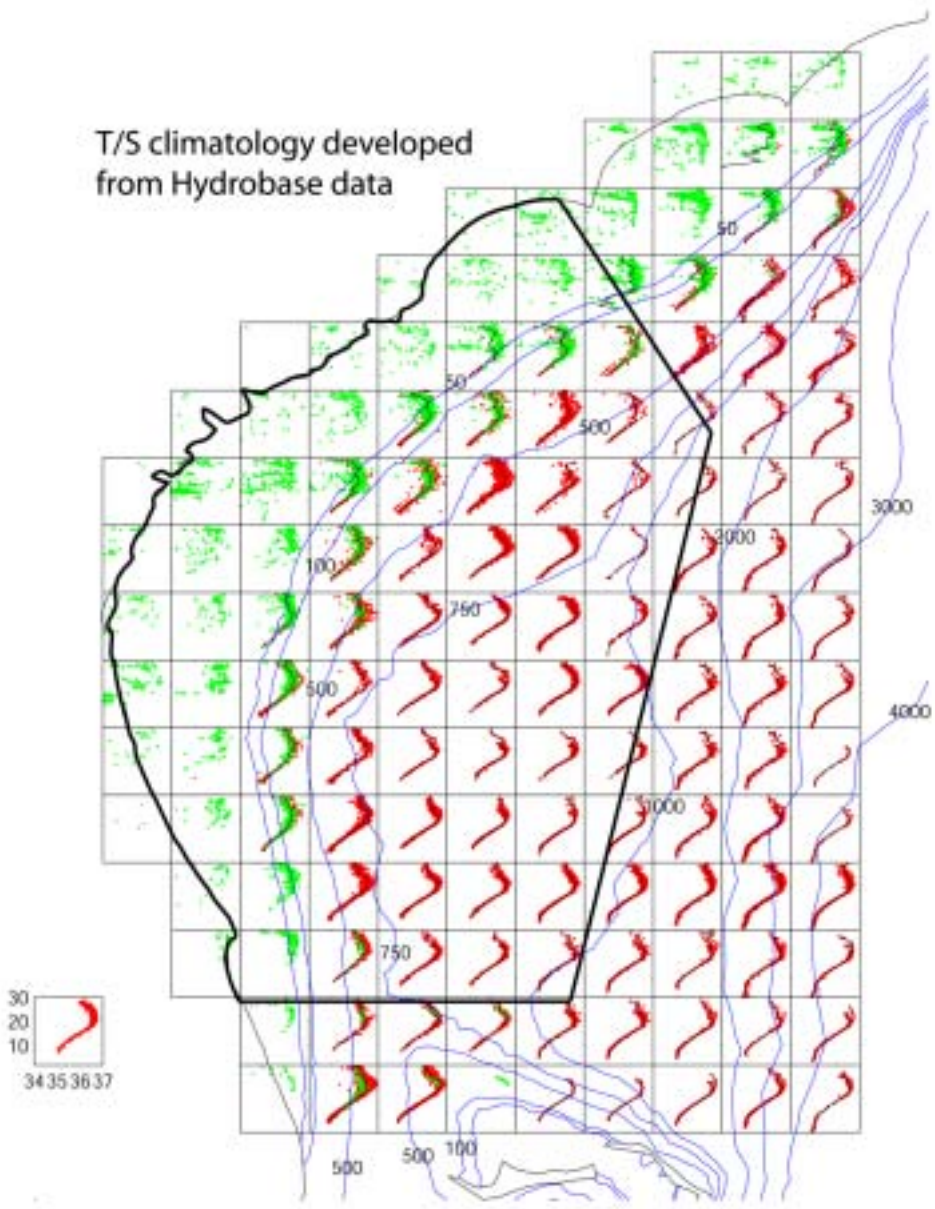

Figure 1. Temperature/salinity relationships derived from the edited Hydrobase data in 0.5 degree squares within the South Atlantic Bight. Red points are data collected in water depths greater than 500 m, green dots are data collected in shallower water. Black lines give the mean T/S relationship with each square that will be used to estimate salinity from temperature measurements.

RELATED PROJECTS

Other direct partners in this NOPP-funded effort are Richard Bolin with TACTS in Beaufort, SC, Dr. Charlie Barans with the Marine Resources Division of the Department of Marine Resources in South Carolina, and Dr. Reed Bohne of the NOAA Gray's Reef National Marine Sanctuary (GRNMS). A new NOPP-funded effort, "Limited-area operational coastal ocean models: assimilation of observations from fixed platforms on the continental shelf and far-field forcing from open ocean models", lead by Dr. Daniel Lynch of Dartmouth College, will make extensive use of the SABSOON observations in a coastal ocean and coastal atmosphere modeling effort over the next two years.

REFERENCES

Curry, R. G., 1996. Hydrobase: A database of hydrographic stations and tools for climatological analysis. Tech. Rep. WHOI-96-01. Woods Hole Oceanographic Institution, 41. pp

Fujita, T. T., 1985. *The Downburst: Microburst and Macroburst*. Univ. of Chicago Press, 122 pp.

Lee, T. N., V. Kourafalou, J. D. Wang, W. J. Ho, J. O. Blanton, L. P. Atkinson and L. J. Pietrafesa, 1985. Shelf circulation from Cape Canaveral to Cape Fear during winter. In: *Oceanography of the southeastern U.S. continental shelf*, L. P. Atkinson , D. W. Menzel and K. A. Bush, editors, Coastal and estuarine series 2, American Geophysical Union, Washington D.C., pp 33-62.

Nelson, J.R., J.E. Eckman, C.Y. Robertson, R.L. Marinelli and R.A. Jahnke, 1999. Benthic microalgal biomass and irradiance at the sea floor on the continental shelf of the South Atlantic Bight: Spatial and temporal variability and storm effects. *Cont. Shelf Res*. **19**: 477-505.

Pietrafesa,, L. J., J. O. Blanton, J. D. Wang, V. Kourafalou, T. N. Lee, and K. A. Bush, 1985. The tidal regime in the South Atlantic Bight. In: *Oceanography of the southeastern U.S. continental shelf*, L. P. Atkinson , D. W. Menzel and K. A. Bush, editors, Coastal and estuarine series 2, American Geophysical Union, Washington D.C., pp 33-62.

Savidge, D. K., J. O. Blanton, T. N. Lee and R. H. Evans, 1992. Influence of an offshore shift in the Gulf Stream on water of the South Carolina continental shelf, J. Phys. Ocean., **22**, 1085-1094.

Schmitz, W. J., Jr., J. R. Luyten and R. W. Schmitt, 1993. On the Florida Current T/S envelope, Bull. Mar Sci., **53**, 1048-1065.

PUBLICATIONS

Seim, H.E., 2000. Implementation of the South Atlantic Bight Synoptic Offshore Observational Network. Oceanography **13(**2): 18-23.

Seim, H.E., J. Bane and P. Welsh, 2000**.** Repeated observations of high frequency extreme wind events over the South Atlantic Bight continental shelf, EOS Trans. AGU, 81 (48), Fall Meeting Suppl., Abstract OS71E-11.